REMARKS

Claims 1 and 2 have been amended in order to more particularly point out and distinctly claim the Applicants' invention. New claim 3 has been added. Thus, claims 1-3 stand for consideration in this application.

Claims 1 and 2 are rejected under 35 U.S.C. § 102(b) as anticipated by Magara (U.S. Patent No. 5,434,380), assigned to the assignee of the present invention, and under 35 U.S.C. § 103(a) as obvious based on a combination of Magara and Graell (U.S. Patent No. 5,187,341). Reconsideration and removal of these rejections are respectfully requested on the basis of the present amendment to the claims and the following remarks.

Magara discloses an electric discharge machining apparatus having a high-voltage superposition circuit that includes current limiting resistors R1 and R2, and transistors TR1 and TR2. During machining, an auxiliary power supply 10b supplies a high voltage to a machining gap 7 when transistor TR1 is switched ON, and thereafter transistor TR2 is switched ON to cause a main power supply 10a to supply a current of low energy.

In contrast with the invention of claims 1 and 2, as now amended, Magara does not disclose that the diameter of the electric discharge arc column is sufficiently extended in the range of the first pulse width. While Magara shows in Fig. 16(b) a pulse having two pulse width sections with different current levels, the same is quite distinct from the present claims where the control means sets the first pulse width and the first peak value such that the electric density between the electrodes can be in a predetermined range to suppress emission of electrode material, and the diameter of the electric discharge arc column is extended in the range of the

first pulse width. Claims 1 and 2, as now amended, clearly identify this feature of the present claimed electric power unit. This feature is clearly described on page 15, lines 18-23, of the present specification and in the drawings, especially Figs. 2A and 2B. Thus, it is submitted that claims 1 and 2, as now amended, are not anticipated by, nor obvious over Magara.

Graell is intended to provide an electro-erosion machine which can reduce the wear of the electrode. Garaell merely discloses in Fig. 10 a step-up current impulse diagram which shows different forms of the rising side of the stepped impulse. For example, Graell discloses at column 5, lines 16-24 as follows:

> So what is invented is the power to vary the slope of the rising side (leading edge) of the current impulse step by step, the breadth of each step being a function of the time and the height, and since a function of the current varies each one of these parameters, it is possible to achieve an infinite range of shapes of the rising side of the impulse of working current, thereby giving it the form most suitable for reducing the wear of the electrode to its minimum value.

The further reference to Graell does not disclose that a control means for setting the first pulse width and the first peak value so that an electric current density between the electrodes can be in a predetermined range to suppress the emission of electrode material, during a period of the first pulse width a diameter of an electric discharge arc column is extended. Thus, the further reference to Graell does not teach or suggest the deficiencies in Magara. Therefore, it is submitted that event the combination of Magara and Graell does not render claims 1 and 2 obvious over these references.

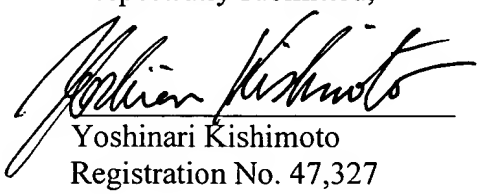
Claim 3 has been added at this time to positively claim that the amount of electrode erosion is intentionally increased to promote the appropriate release of coat-formation elements into the gap, following the initial suppression period. The prior art clearly does not envision such a methodology.

In view of the foregoing, the claims are now believed to be in form for allowance, and such action is hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, he is kindly requested to contact the undersigned at the telephone number listed below.

Attached hereto is a copy of version with markings to show changes made.

Applicants hereby petition for any extension of time which may be required to maintain the pendency of this case, and any required fee, except for the Issue Fee, for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,



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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 2, paragraph 1 , which bridges over to page 3:

However, according to the investigations made by the present inventors, the following knowledge has been ~~found out~~gained. When an electrode for electric discharge surface treatment made of material such as Ti (titanium) capable of forming a hard carbide is used and electric discharge is generated between the electrode and metal of a workpiece, it is possible to form a strong hard coat on the metal surface of the workpiece without being subjected to the process of remelting. The reason why the strong hard coat is formed on the metal surface is that the electrode material, which has been consumed by electric discharge, reacts with C (carbon) which is a component of the processing solution, so that TiC (titanium carbide) can be created. Also, the following knowledge has been ~~found out~~gained. When a pressed powder electrode, which is an electrode for electric discharge surface treatment made of metal hydride such as TiH_2 (hydrogenat~~ion~~ed titanium), is used and an electric discharge is generated between the pressed powder electrode and the metal of a workpiece, it possible to form a hard coat more quickly, the adhering property of which is higher than that of a case in which Ti is used. Further, ~~the following knowledge has been found out. When~~the inventors have learned that when a pressed powder electrode, which is an electrode for electric discharge surface treatment in which a hydrogenat~~ion~~ed compound such as TiH_2 is mixed with other metal or ceramics, is used and an

electric discharge is generated between the pressed powder electrode and the metal of a workpiece, it is possible to quickly form a hard coat of various hardness and abrasion resistance property.

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) An electric power unit for electric discharge surface treatment by which electric discharge is generated between an electrode for electric discharge surface treatment and a workpiece so that a hard coat is formed on a surface of the workpiece, ~~by~~ ~~the~~ energy of electric discharge, ~~the electric power unit for electric discharge surface treatment~~ comprising:

a control means for dividing an electric discharge current pulse into a first pulse width ~~T1~~ (with a first peak value ~~Ip1~~), a second pulse width ~~T2~~ (with a second peak value ~~Ip2~~), . . . , and an n-th pulse width ~~Tn~~ (with an n-th peak value ~~Ipn~~) (n is an integer equal to 2 ~~and~~or more),

wherein the control means ~~for setting~~sets the first pulse width ~~T1~~ and the first peak value ~~Ip1~~ so that an electric current density between the electrodes can be in a predetermined range to suppress ~~the~~ emission of electrode material, and so that during a period of the first pulse width a diameter of an electric discharge arc column is extended, and

the control means ~~for setting~~sets the k-th pulse width ~~Tk~~ and the k-th peak value ~~Ipk~~ ($2 \leq k \leq n$, k is an integer) so that a quantity of supply of hard coat material by the emission of

electrode material can be a predetermined value determined according to a predetermined processing condition.

2. (Amended) A method of electric discharge surface treatment for forming a hard coat on a surface of a workpiece by which electric discharge is generated between an electrode for electric discharge surface treatment and the workpiece so that the hard coat is formed on the surface of the workpiece, ~~by the energy of electric discharge, the method of electric discharge surface treatment~~ comprising the steps of:

dividing an electric discharge current pulse into a first pulse width ~~T1 (~~with a first peak value ~~Ip1)~~, a second pulse width ~~T2 (~~with a second peak value ~~Ip2)~~, . . . , and an n-th pulse width ~~Tn (~~with an n-th peak value ~~Ipn)~~ (n is an integer equal to 2 and more);

setting the first pulse width ~~T1~~ and the first peak value ~~Ip1~~ so that an electric current density between the electrodes can be in a predetermined range to suppress ~~the~~ emission of electrode material, and so that during a period of the first pulse width a diameter of an electric discharge arc column is extended; and

setting the k-th pulse width ~~Tk~~ and the k-th peak value ~~Ipk~~ ($2 \leq k \leq n$, k is an integer) so that a quantity of supply of hard coat material by the emission of electrode material can be a predetermined value determined according to a predetermined processing condition.

Claim 3 is added as new claims.